Tree Farm License 49

Inventory Plan

MINISTRY OF FORESTS
RESOURCES INVENTORY BRANCH
JUNE, 1998

106-06863/

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1. INTRODUCTION

1.1 Background

The Provincial Vegetation Resources Inventory (VRI) or Provincial Inventory is an improved vegetation (forest) inventory process or toolbox for assessing the quantity and quality of British Columbia's timber and other vegetation resources. It addresses the concerns expressed by the Forest Resources Commission in its 1991 report, *The Future of our Forests*. These concerns included:

- lack of statements of precision of the inventory;
- inadequate information on non-timber vegetation resources;
- lack of reliable estimates of growth rates and stand specific volumes; and
- narrow focus on commercial timber volume and the timber harvesting landbase.

The VRI can be implemented at a number of levels depending on the business needs. It can be deployed over the entire province (one or more Forest District at a time), measuring all the timber and non-timber resources. The VRI can also be deployed over a Management Unit (TFL or TSA) or a small watershed within a District, measuring selected resources in specific portions of the landbase.

The Provincial Inventory consists of a system of protocols, models and databases that can be managed through a dispersed computing environment. The Provincial Inventory process can be used to meet today's needs for timber supply, long term planning, silviculture planning, defining sustainability, public information and credibility. The Provincial Inventory can also provide data for computer modeling and decision support systems to support a baseline biodiversity assessment and for research.

The Vegetation Resources Inventory is designed to determine:

- the amount of vegetation cover in the province;
- the location of vegetation resources in the province; and
- the changes in the amount and location of vegetation resource over time.

The principles guiding the implementation of the inventory are:

- to integrate provincial inventory activities (e.g. Management Inventories, Provincial Inventory, National Forest Inventory and Monitoring);
- to implement inventory projects to satisfy business requirements as defined in the inventory plans; and
- to maximize the usefulness of sample plots and minimize overall costs by implementing a cascading plot approach that ensures that information collection meets the VRI standards while meeting multiple goals.

Management Inventories include inventories conducted in Implementation Units[1], to fulfill specific forest management or business needs. Sampling error and sampling intensity are controlled for specific vegetation attributes (e.g., timber volume) to achieve specific inventory objectives. There are several types of Implementation Units in the province: Timber Supply Areas (TSAs), Tree Farm Licenses (TFLs), and other lands (parks, private lands, and other public lands). Within (or across) these Implementation Units there may be Management Inventories addressing specific issues such as Problem Forest Types, or other strata in a TSA (or groups of TSAs).

Management Inventories are typically timber emphasis inventories. Besides providing detailed polygon information for day-to-day forest management, they can also be used to increase precision of the Provincial Inventory. The TFL holders or the MoF Regions/Districts are responsible for the planning and implementation of these inventories. However, the Ministry of Forests Resources Inventory Branch requires the TFL holder(s), stakeholder(s), or District(s) to prepare an inventory business plan, which includes a sampling plan, for its approval. An inventory business plan defines the inventory needs, the information needed to meet the needs, and the methods for collecting the information. This business plan then drives the inventory project plans.

1.2 Objectives

This is a plan for implementing the Management Inventory activities in Tree Farm License (TFL) 49 in the Kamloops Forest Region. This plan was developed through consultation with various stakeholders in the TFL 49, including the Ministry of Forests (MOF) (Resources Inventory Branch, Kamloops Forest Region, Vernon and Penticton Forest Districts) and Riverside Forest Industries (TFL 49) staff who identified local inventory needs and priorities.

The purpose of the Inventory Plan is to:

1. define the Management Inventory objectives; and
2. outline the implementation steps.

This plan is based on the consultant report, *Tree Farm License 49 Vegetation Resources Inventory Ground Sampling Plan*, prepared by J.S. Thrower & Associates. The report was prepared following the procedures outlined in the Ministry of Forests, Resources Inventory Branch procedures, *Vegetation Resources Inventory: Preparing a sampling plan for ground sampling* (March 1997). The report has been reviewed by stakeholders and is attached to this Inventory Plan (Appendix A).

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[1] Implementation Units are a specified area of land such as a TSA, TFL, Innovative Forest Practices Agreement area, etc. For any Implementation Unit, there can be none to several Management Inventories based on stakeholder business needs.

2. BUSINESS CONSIDERATIONS

2.1 Inventory Issues

The main inventory issue for TFL 49 is the accuracy of the timber volume in the TFL. The accuracy of this attribute is in question because a statistically valid inventory audit has not been performed in this area. However, a yield analysis is planned for the unit in 1998, and there is interest in localizing the operational adjustment factors (OAFs)[2] for the TFL for use in the yield analysis.

3. INVENTORY PLAN

TFL 49 falls within the Okanagan TSA (Penticton and Vernon Forest Districts). As of yet, there has been no work undertaken on the Provincial Inventory within the Okanagan TSA. This will be completed at a later date and TFL 49 ground sampling contribution to the Provincial Inventory will be determined at that time. As such, this is a Management Inventory Plan only.

3.1 Management Inventory

The inventory unit for the VRI timber emphasis inventory is TFL 49. Typically, the inventory unit for VRI ground sampling is one or more Forest Districts.[3] However, the MOF and the stakeholder decided to treat TFL 49 as a separate inventory unit for timber emphasis sampling to allow for improvements in the timber inventory prior to the next round of timber supply analysis (1998). This TFL will also act as a case study for comparing timber inventories with the VRI Phase I and Phase II timber emphasis components because both phases will have been completed. The Resources Inventory Branch will complete data compilation and analysis.

3.1.1 Management Unit Landbase

TFL 49 covers approximately 145,000 ha and is located in the Kamloops Forest Region. Approximately 100% of the TFL 49 is considered operable. The TFL does not contain any ecological reserves or parks.

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[2] OAFs reduce potential yield predicted from growth models to account for operational conditions.

[3] An inventory unit is the target population from which the samples are chosen. A *Forest District* was chosen as the inventory unit for implementing the VRI province-wide because it formed a large enough unit to provide a framework for more detailed sampling of sub-units. The provincial District boundaries correspond to the existing management units (TSAs) used for planning in most cases, and administrative/planning infrastructure is in place at the District level in most cases as well. The District forms a cost-effective grouping of the various forms of land tenure (e.g., TSA, TFL, private land, ecological reserves, parks, and recreation areas). Although smaller groupings (e.g., watershed) are possible, they would be more expensive to implement throughout the province. Further aspects of VRI ground sampling are discussed in Appendix A.

3.1.2 Objectives

3.1.2.1 Photo Interpretation

Timberline Forest Inventory Consultants of Prince George has completed the photo interpretation (Phase 1) for this unit to RIC Standards. This information will be used for the current inventory.

3.1.2.2 Ground Sampling

The sampling objective for the TFL 49 inventory is to check and improve the accuracy of the existing timber inventory in the TFL using a *timber emphasis inventory*. This would include measurement of large trees, small trees, and site trees using VRI definitions and protocols.[4] The number of samples will target a sampling error of ±10% (95% probability) for timber volume in the treed (BC Land Cover Classification Scheme) mature (80+ years) portion of the TFL.

The population of interest is the entire TFL landbase, including treed areas, non-treed areas, and forests of all age classes. The database to be sampled will be generated from the recently completed VRI Phase I inventory.

Two sampling strata will be created in TFL 49 based on Phase I attributes. Stratum 1 will include all treed (BC Land Cover Classification Scheme) mature (80+ years) polygons in the population. Stratum 2 will consist of the remaining polygons (treed immature and non-treed). Stratum 1 is of greater interest and covers roughly 60% of the landbase.

3.1.3 Sampling Plan

> To achieve the objectives of the Management Inventory, Timber Emphasis Sampling will be required. The Timber Emphasis Sampling must meet the minimum sampling requirements as specified in *Implementation Strategy to Integrate Management, Provincial and National Inventories* (MoF, Resources Inventory Branch)

The number of samples in an inventory generally depends on several factors including theoretical considerations, available funds, available staff, timelines, and length of field season. Calculation of a theoretical target sample size requires an estimate of variation in the key attributes of interest under the proposed sampling procedures [often expressed as the coefficient of variation (CV)]; and a statement of the precision desired in the attributes.

For example, assuming a CV of 40-80%, the theoretical target sample size for estimating net timber volume to a target precision of ±10% (95% probability) would be 60-240 sample clusters (Figure 6). A preliminary total sample size of about 200 sample clusters for planning, training, and other logistic considerations will be used.

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[4] VRI ground sampling procedures (March 1997). Copies of the VRI ground sampling procedures are available on the Internet at: http://www.for.gov.bc.ca/resinv/veginv/standard/sampveg/march97/toc.htm, or from Superior Reprographics, #200-1112 West Pender Street, Vancouver BC, V6E 2S1.

The actual sample size needed to achieve the target sampling error of ±10% (95% probability) will be calculated after a preliminary sample is measured.

The implementation should proceed in a manner similar to the Provincial Inventory ground sampling. The sampling will be spread over a period of 2 years, with unbiased interim results expected after the first season. Sampling in the first year will provide experience to refine the process for the second field season and information to calculate precisely the remaining number of samples required to meet the precision target of ±10%.

Two additional ground sampling activities support the VRI process: Net Volume Adjustment Factor (NVAF) sampling and Within Polygon Variation (WPV) sampling. The NVAF sampling must be completed as net volume estimates may be biased, however, no WPV sampling will be done in the TFL at this time. WPV sampling will instead be completed when the VRI Phase II sampling is implemented in the Penticton and Vernon Forest Districts.

4. IMPLEMENTATION STRATEGY

The ground samples that are established to meet the Management Unit objectives are not compatible with the Provincial Inventory objectives as the dual-purpose plots were not identified before establishment. The Provincial Inventory will be completed at a latter date to the Ministry of Forests minimum standards as outlined in *Implementation Strategy to Integrate Management, Provincial and National Inventories.* Ground sampling information from Management Inventory will be able to be incorporated into the Provincial Inventory at a latter date.

4.1 Steps

We recommend implementing the sampling in a two-step process to achieve the sampling objective. Seventy samples (suggested at the Stakeholders meeting) should be installed in the 1997 field season. Eighty percent of these polygons should be installed in Stratum 1 and 20% in Stratum 2. The remaining plots can be installed in the second field season, in the same strata proportions, if needed. The samples should be selected systematically from the sorted list of 500 potential sampling points in each stratum. Sampling in the first field season will provide experience to refine the process for the second field season. It will also provide information to calculate precisely the remaining number of samples required to achieve the precision target of ±10% for timber volume in the treed, mature landbase. NVAF sampling could start in 1998 and continue in 1999.

4.1.2 Implementation Process

The implementation process will proceed based on available funding and can be implemented based on a number of scenarios. All implementation scenarios will follow a common process. One possible implementation process could proceed as follows:

1. Select 500 potential sampling points from each sorted list of polygons.
2. Set the estimated total sample size for the first half of the field season (e.g., 70), depending on crew availability and time.
3. Systematically select a batch of sampling points from the Stratum 1 and Stratum 2 lists, 80% of the samples (e.g., 56) should be in Stratum 1, and 20% (e.g., 14) in Stratum 2.
4. Systematically select a sub-sample of 15 NVAF sampling points (75 trees) from the 70 Phase II ground sampling points.
5. Begin planning for field sampling as soon as possible.
6. Prepare a field sampling plan that includes plot batches to ensure an unbiased sample is obtained at the end of the first half of the field season. Identify NVAF sample points and ensure they are field sampled early in the field season.
7. Locate and measure sample clusters (tree attributes only) in the selected sampling points in the summer 1997. The following VRI field plot card types will be used: #1 (header), #2 (getting to plot), #3 (plot layout), #8 (tree details), #9 (tree loss indicators), #10 (small tree, stump, and site tree), and #11 (auxiliary plot).
8. Carefully monitor quality assurance of field data and procedures during field sampling. Arrange for check cruisers to sample auxiliary plots of NVAF samples.
9. Compile the data in winter 1997. This will include computing averages of timber volume, regression of photo estimated volume to ground sample volume, the associated standard error of the regression, and the statistical adjustment of all polygon Phase I estimates in the treed and non-treed polygons. Calculate the required sample size by early spring 1998.
10. Prepare NVAF tree sampling matrix.

Step 2 – 1998 Field Season

11. Locate and measure remaining sample clusters in the same proportions in Stratum 1 and Stratum 2 (i.e., 80% and 20%). Complete stem analysis of the NVAF sample trees.
12. Compile all data, complete the statistical adjustments with proper weighting, and load the final inventory results into the Provincial and TFL 49 databases by fall 1998.

4.2 Cost

4.2.1 Management Inventory

Table 1 identifies the costs for completing this Management Inventory Plan for TFL 49.

Table 1. Estimated costs required to complete the Management Inventory sample plan.

Ground Sampling Unit	Sample size	Unit Cost ($)	Total Cost ($)
Management Unit			
Stratum 1 - Treed, mature - Plots	160	1,500	240,000
Stratum 2 - remainder of area - Plots	40	1,500	60,000
NVAF - Trees	75	500	37,500
Total			337,500

The sample size determination for the Management Unit sampling can be found in the consultant report in Appendix A. The required number of Management Inventory samples is based on the appropriate CV (estimated) and the objective precision level of ±10% sampling error (at the 95% probability level).

The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level, will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

4.3 Monitoring

The Ministry of Forests, Resources Inventory Branch is responsible for monitoring this Inventory Plan.

5. APPROVAL/SIGNING

I have read and concur with the TFL 49 Inventory Plan, June 26, 1998. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories and then appended to this plan.

Riverside Forest Products
General Manager, TFL 49

District Manager
Vernon Forest District

Regional Manager
Kamloops Forest Region

Director
Resources Inventory Branch

District Manager
Penticton Forest District

Appendix A

Tree Farm Licnence 49
Vegetation Resources Inventory
Ground Sampling Plan

Appendix B

Polygon Selection